

Akira TAKAHASHI* & Michio TAMURA**: Occurrence of
vessel elements in the stem of *Sarcandra glabra*

高橋 晃*・田村道夫**: センリョウの茎における道管要素の分布

Sarcandra glabra has long been known as a member of vesselless dicotyledons (Swamy & Bailey 1950, Swamy 1953). Recently, however, Carlquist (1987) reported the presence of vessels in the secondary xylem of root. Takahashi (1988) also detected the vessels in the metaxylem of stem. In this paper, by means of scanning electron microscopy, we will report at what part of the stem the vessel elements are formed.

Materials and methods The stems of *Sarcandra glabra* (Thunb.) Nakai were collected from Iriomote Isl., Okinawa Pref. (vouchers: Okada *et al.* 206, 207, 250, 271, in Herbarium of Kobe University) and immediately fixed in FAA. Methods for light and scanning electron microscopy were the same as those used by Takahashi (1988).

Results and discussion The stem is 10–15 mm in diameter, and in the cross section, 30–40 vascular bundles are arranged in a ring. Each vascular bundle is composed of secondary xylem of 2–3 mm thickness and a small amount of primary xylem. Fascicular cambia produce tracheary elements, while inter-fascicular cambia produce sclerified parenchyma cells which develop into multi-seriate rays. The width of the vascular bundles varies from 100 to 700 μm and the number of cells in tangential direction varies from 5 to 40. The width of each vascular bundle and the number of cells do not increase greatly during the secondary growth.

In radial section, the inner elements of the primary xylem have helical thickenings, and the outer elements have scalariform pits at the end walls. In the secondary xylem, earlier formed innermost elements have scalariform pits, which are shorter than those in the primary xylem. Later formed elements have circular bordered pits with oblique apertures. The tracheary elements are generally the thickest in the metaxylem and become narrower toward the out-

* Department of Biology, College of Bio-Medical Technology, Osaka University, Toyonaka, Osaka 560.
大阪大学 医療技術短期大学部生物.

** Department of Biology, Faculty of Science, Kobe University, Kobe 657. 神戸大学 理学部生物学教室.

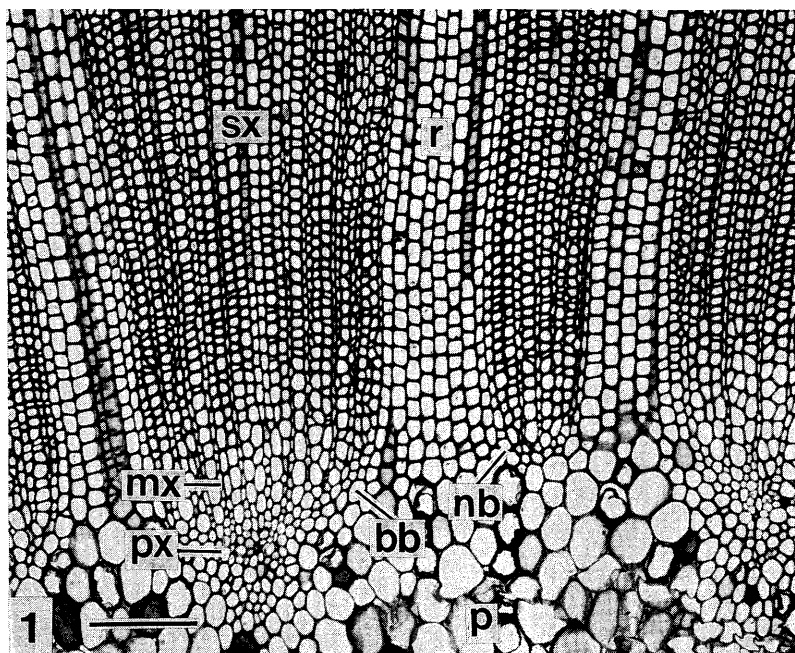
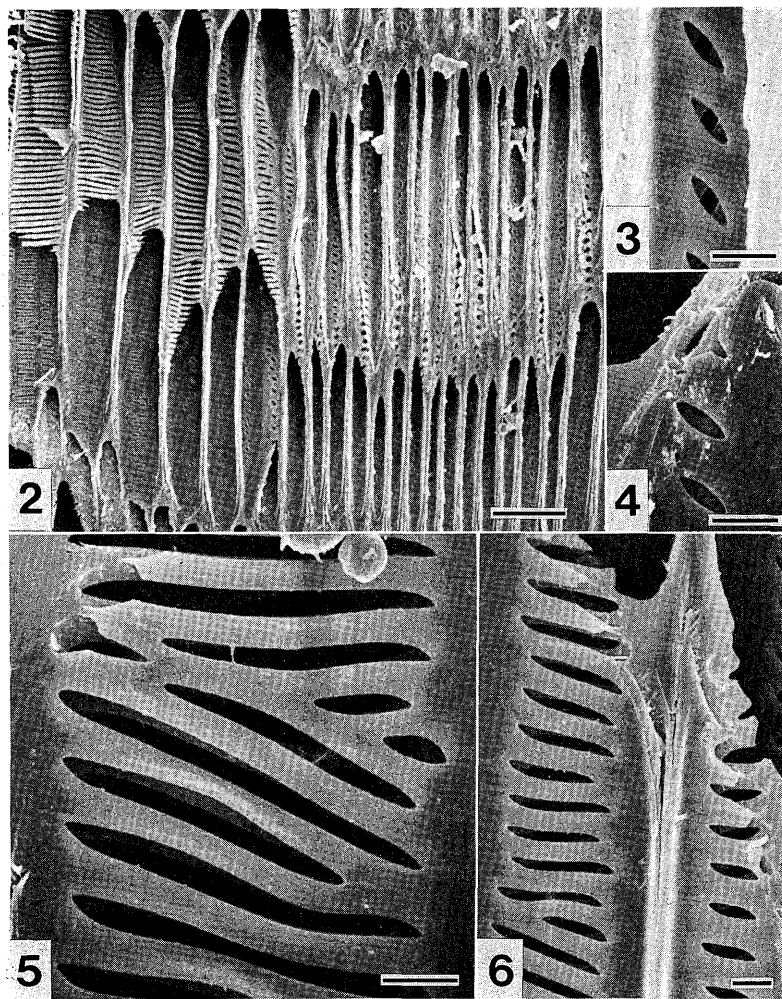


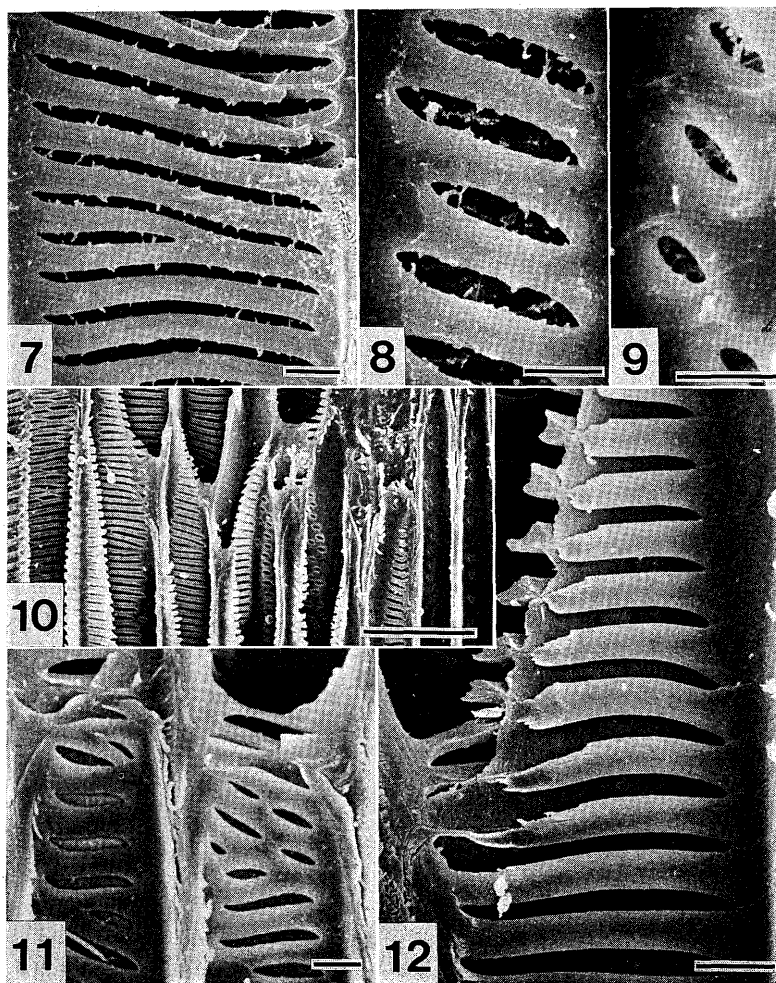
Fig. 1. Cross section of stem. bb, broad vascular bundle; mx, metaxylem; nb, narrow vascular bundle; p, pith; px, protoxylem; r, multiseriate ray; sx, secondary xylem. Bar=200 μ m.

side.

In the broad vascular bundles (Fig. 2), the pit membranes are not always present in the tracheary elements. The membranes are not observed in scalariform pits of metaxylem elements (Fig. 5) and in scalariform (Fig. 6) and circular pits (Fig. 3) of earlier formed secondary xylem elements. In later formed secondary xylem, however, the membranes are present in circular pits of its elements (Fig. 4). Occasionally, granular or thread-like substance is observed in the scalariform and circular pits (Figs. 7-9). These substance seems to be the debris of disintegrated membranes. The metaxylem elements are 26-50 μ m in radial diameter with the scalariform pits whose apertures are 14-38 μ m $\times$ 1.0-2.3 μ m and regarded as vessel elements because of the absence of pit membranes. The elements of earlier formed secondary xylem are 19-34 μ m in radial diameter with the scalariform pits whose apertures are 5-18 μ m $\times$ 1.0-1.8 μ m and also regarded as vessel elements. The elements of later formed secondary



Figs. 2-6. Scanning electron micrographs of radial sections of broad vascular bundles. 2. Metaxylem (left side) to secondary xylem (right side). 3. Element of earlier formed secondary xylem, showing circular pits without pit membranes. 4. Element of later formed secondary xylem, showing circular pits with pit membranes. 5. Metaxylem element, showing scalariform pits without pit membranes. 6. Elements of earlier formed secondary xylem, showing scalariform pits without pit membranes. Bar=50 μ m in Fig. 2, and 5 μ m in others.



Figs. 7-12. Scanning electron micrographs of radial sections of broad vascular bundle (7-9) and narrow vascular bundle (10-12). 7-9. Elements of metaxylem (7) and secondary xylem (8 & 9), showing granular substances in their pits. 10. Metaxylem (left side) to secondary xylem (right side). 11. Elements of earlier formed secondary xylem, showing scalariform pits with pit membranes. 12. Metaxylem element, showing scalariform pits with pit membranes. Bar= 50 μ m in Fig. 10, and 5 μ m in others.

xylem are 10–28 μm in radial diameter with the circular pits whose apertures are 3–5 $\mu\text{m} \times 1.0$ –1.4 μm and regarded as tracheids because of the presence of pit membranes.

In the narrow vascular bundles (Fig. 10), the membranes are always observed in the scalariform pits of metaxylem elements (Fig. 12) and in those of secondary xylem elements (Fig. 11). The metaxylem elements are 20–43 μm in radial diameter with the scalariform pits whose apertures are 12–36 $\mu\text{m} \times 1.0$ –2.0 μm . The elements of earlier formed secondary xylem are 16–36 μm in radial diameter with the scalariform pits whose apertures are 4–12 $\mu\text{m} \times 1.0$ –1.8 μm . The elements of later formed secondary xylem are 12–30 μm in radial diameter with the circular bordered pits whose apertures are 3–5 $\mu\text{m} \times 1.0$ –1.3 μm . These elements are regarded as tracheids because of the presence of pit membranes.

The above description shows that in the broad vascular bundles, the elements of metaxylem and earlier formed secondary xylem are 19 to 50 μm in radial diameter and have no pit membranes, while in the narrow vascular bundles, the metaxylem elements have pit membranes even if they are as thick as 40 μm . The loss of pit membrane (i.e., vessel formation) is not affected by the thickness of tracheary elements at least in *Sarcandra*. In this genus, the vessel elements occur in the earlier formed secondary xylem, as well as in the metaxylem.

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無道管双子葉植物の一員とされてきたセンリョウ科センリョウにおいて、最近、根と茎の木部から道管が見いだされた。本研究では、道管が茎のどの部分にあるのか一層詳しく知るために走査型電顕を用いて調べた。後生木部要素は他部分の要素よりいくぶん太く、末端に階段状壁孔を有している。二次木部のうち初期に形成された要素は階段状壁孔を有しているが、後期に形成された要素は円形壁孔を有している。茎には横断面でみると広い維管束と狭い維管束がある。広い維管束の後生木部要素と初期二次木部要素の階段状壁孔には壁孔膜がないが、後期二次木部要素の円形壁孔には壁孔膜が観察された。また狭い維管束のすべての要素には壁孔膜が観察された。すなわちセンリョウの道管要素は階段状穿孔をもち、広い維管束の後生木部と初期二次木部に存在することがわかった。また壁孔膜の有無と管状要素の太さとの相互関係を調べたところ、壁孔膜の消失すなわち道管形成と管状要素の直径には明らかな関係のないことがわかった。

□ Gifford, E. M. & A. S. Foster: **Morphology and evolution of vascular plants**, 3rd ed. 626 pp. Freeman and Company. ¥ca. 14,000. 本書は2版まで Comparative morphology of vascular plants (Foster & Gifford) と表題されてきた、名高い教科書の第3版である。2版の出版される前年の1973年に亡った Foster が第2著者になっている。第2版の書評を本誌に書いた (50: 114, 1975) ときに指摘した上級分類群の選択についての著者の見解が後退し、ほぼ現在の通説に従っている。年々増加するぼう大な文献から重要なものだけを選択するだけでも大変な仕事になってきている。本書では1版や2版にあった個性は薄らいだが、維管束植物の基本構造に学ぶためには、やはり出色の教科書ではないだろうか。 (大場秀章)

□ 滝 一郎: **じゃがじゃが植物記** 211 pp. 1989. 鉦脈社 (〒880 宮崎市田代町 263). ¥800 (税込). 「じゃがじゃが」とは日向弁で「そうだそうだ」の意味だという。宮崎県の新聞にこの表題で、同じく雑誌に「三味線蔓」の題で連載したもの、合計71項目の話を集めたのがこの本である。著者は永年宮崎県の小・中学校、博物館で理科の先生を歴任し、植物の研究と教育に経験の深いかたである。自然に恵まれた南九州の人々が、子供のころ毎日見て、触れて、遊んで、食べて親しんだ草木が次々と出て来るが、県外のまた大都会などの人も「そうだそうだ」と同感しそうな植物との付き合いの楽しさに満ちている。一般向きの読み物である。私も初めて知ったこと、なるほどと思ったこと、それに日向弁の解説などもあって、興味深く通読した。 (伊藤 洋)